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10/577,450	04/27/2006	Sadamasa Fujii	AI 408NP	4769

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EXAMINER	
TAYLOR, EARL N	

ART UNIT	PAPER NUMBER
2818	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/577,450	FUJII ET AL.	
	Examiner	Art Unit	
	EARL N. TAYLOR	2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 October 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 April 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *4/27/2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Group I, claims 1-7, in the reply filed on 28 October 2008 is acknowledged.

Priority

Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

This office acknowledges receipt of the following items from the applicant: Information Disclosure Statement (IDS) filed on 27 April 2006. The references cited on the PTOL 1449 form have been considered.

Drawings

The drawings are objected to because Fig. 4(a) points to the substrate (wavy line not the arrow) with character number "1" and should be character number --11--. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an

amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

Claims 2-7 are objected to because of the following informalities:

Claims 2-5 recite "An electronic device as set …" and should read --The electronic device as set …--.

Claims 6 and 7 recite "an electronic device as recited in claim 4" and should read –the electronic device as recited in claim 4--.

Claim 7 also recites "a bump" and should read --the bump--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112, 2nd paragraph

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites "the second metal material having a lower melting point in an elemental state than an alloy of the first metal material and the second metal material".

As per the applicant's specification, the first metal material can be gold (Au) or copper (Cu) and the second metal material can be tin (Sn), indium (In) or tin-indium (Sn—In).

For example, if the first metal is copper (Cu) and the second metal is tin (Sn) then tin (Sn) in an "elemental state" would have to have a lower melting point than an alloy Cu—Sn.

The problem is that the claim does not specify the composition percentage of the elements in the alloy being compared. In other words, tin (Sn) does not always have a lower melting point than an alloy of Cu—Sn. Specifically, the claim language does not account for the eutectic temperature for these disclosed alloys, which is the lowest melting point possible of the alloy. The eutectic temperature is always lower than the individual melting points of either "elemental" part of the alloy for the alloys disclosed.

The examiner has provided alloy phase diagrams for Au—Sn, Au—In, Cu—Sn, and Cu—In from ASM Materials Information Handbook.

The melting point of tin (Sn) at atmospheric pressure is 231.9681°C. The Cu—Sn alloy has a composition percentage wherein the melting point is 227°C and the Au—

Sn alloy has a composition percentage wherein the melting point is 217°C. Both alloys have a lower melting point than the "elemental state" of tin (Sn).

The melting point of indium (In) at atmospheric pressure is 156.634°C. The Cu—In alloy has a composition percentage wherein the melting point is 153°C and the Au—In alloy has a composition percentage wherein the melting point is ~156°C. Both alloys have a lower melting point than the "elemental state" of indium (In).

Claim 3 recites "the diffusion prevention film … uncovers the rest of the top surface". It is unclear if this is a removal step or not. Does the applicant mean --the diffusion prevention film … does not cover another part of the top surface of the bump--?

Claim 7 recites that the substrate is an insulating substrate and claim 4 recites that the substrate is a semiconductor substrate. It is unclear as to the material properties required of substrate. Fig. 2 and related text shows substrate (11) to be a semiconductor substrate (e.g., a silicon substrate). Fig. 6-7 and related text shows substrate (41) to be an insulating substrate. Therefore, the substrate cannot be both a semiconductor and an insulator.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 2 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by DiGiacomo et al. (U.S. Patent 5,367,195) as evidenced by ASM Handbooks Online (Volume 3, Alloy Phase Diagrams).

As insofar as Claim 1 is definite, DiGiacomo teaches in Fig. 1 and 4 for example an electronic device comprising: a substrate (12); a bump (16) of a first metal material (Cu; Copper; Col. 6, Lines 25-28) provided on a surface of the substrate (12); a bonding film (20) of a second metal material (Sn; Tin for example; Col. 6, Lines 23-25) provided on a top surface of the bump (16), the second metal material (Sn) having a lower melting point in an elemental state than an alloy of the first metal material (Cu) and the second metal material (Sn); and a diffusion prevention film (17/18) of a third metal material (Ti/Mo; Titanium/Molybdenum; Col. 5, Lines 53-55) provided between the top surface of the bump (16) and the bonding film (20) as covering at least part of the top surface of the bump (16), the third metal material (17/18; Mo/Ti) having a lower diffusion coefficient than the second metal material (Sn) with respect to the first metal material (Cu).

As shown in the alloy phase diagram, Sn has a melting point of 231.9681°C which is lower than the melting point (415°C) of a Cu—Sn alloy when the weight percent tin is 92.4 for example. Furthermore, these are specifically materials in the applicant's specification therefore must meet the claimed properties.

The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for bonding the electronic device to an electrical connection portion of a second device" does not distinguish the present invention over the prior art of DiGiacomo who teaches the structure as claimed.

The manner in which the claim is written does not require (or comprise) an electrical connection portion or a second device.

As insofar as Claim 2 is definite, DiGiacomo further teaches wherein the diffusion prevention film (17/18) covers the entire top surface of the bump (16), and the bonding film (20) is entirely disposed on the diffusion prevention film (17/18).

As insofar as Claim 5 is definite, DiGiacomo further teaches wherein the substrate (12) is a wiring board having a wiring conductor (14) provided on an insulating substrate (ceramic for example), and the bump (16) is provided on the wiring board and connected to the wiring conductor (14) (Col. 5, Lines 28-34).

As insofar as Claims 4 and 7 are definite, DiGiacomo teaches a semiconductor chip comprising: a wiring board having a wiring conductor (15) provided on an insulating substrate (12); the electronic device being connected to the wiring conductor (15) with the bump (16) thereof opposed to the wiring board.

Claims 1 and 2 are rejected under 35 U.S.C. 102(e) as being anticipated by Yeo (U.S. Patent Application Publication 2005/0224991 A1).

As insofar as Claim 1 is definite, Yeo teaches in Fig. 4B for example an electronic device comprising: a substrate (120); a bump (150) of a first metal material (Cu or Au; Copper or Gold; par. 52) provided on a surface of the substrate (120); a bonding film (180) of a second metal material (In—Sn alloy for example; par. 47) provided on a top surface of the bump (150), the second metal material (In—Sn) having a lower melting point in an elemental state than an alloy of the first metal material (Cu of Au) and the second metal material (In—Sn); and a diffusion prevention film (180A) of a third metal material (Ni; Nickel; par. 53) provided between the top surface of the bump (150) and the bonding film (180) as covering at least part of the top surface of the bump (150), the third metal material (Ni) having a lower diffusion coefficient than the second metal material (In—Sn) with respect to the first metal material (Cu or Au).

These are specifically materials in the applicant's specification for the first, second and third metal layers therefore must meet the claimed properties.

The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in

order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for bonding the electronic device to an electrical connection portion of a second device" does not distinguish the present invention over the prior art of Yeo who teaches the structure as claimed.

The manner in which the claim is written does not require (or comprise) an electrical connection portion or a second device.

Referring to Claim 2, Yeo further teaches wherein the diffusion prevention film (180A) covers the entire top surface of the bump (150), and the bonding film (180) is entirely disposed on the diffusion prevention film (180A).

Claims 1, 2 and 4 are rejected under 35 U.S.C. 102(b) as being anticipated by Zakel et al. (U.S. Patent Application Publication 2002/0047217 A1).

As insofar as Claims 1 and 4 are definite, Zakel teaches in Fig. 3 for example an electronic device (semiconductor chip) comprising: a semiconductor substrate (100; par. 42); a bump (110) of a first metal material (Au; Gold; par. 31) provided on a surface of the substrate (100); a bonding film (150) of a second metal material (Sn; par. 39) provided on a top surface of the bump (110), the second metal material (Sn) having a lower melting point in an elemental state than an alloy of the first metal material (Au) and the second metal material (Sn); and a diffusion prevention film (120) of a third metal

material (Ti; par. 24) provided between the top surface of the bump (110) and the bonding film (150) as covering at least part of the top surface of the bump (110), the third metal material (Ti) having a lower diffusion coefficient than the second metal material (Sn) with respect to the first metal material (Au).

These are specifically materials in the applicant's specification for the first, second and third metal layers therefore must meet the claimed properties.

The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for bonding the electronic device to an electrical connection portion of a second device" does not distinguish the present invention over the prior art of Yeo who teaches the structure as claimed.

The manner in which the claim is written does not require (or comprise) an electrical connection portion or a second device.

Referring to Claim 2, Zakel further teaches wherein the diffusion prevention film (120) covers the entire top surface of the bump (110), and the bonding film (150) is entirely disposed on the diffusion prevention film (120).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zakel (U.S. Patent Application Publication 2002/0047217 A1) in view of Hikita et al. (U.S. Patent 6,133,637).

As insofar as Claim 6 is definite, Zakel teaches the limitations of Claims 1 and 4 in Fig. 3, but does not explicitly show a second semiconductor chip bonded to the bump of the first semiconductor chip. Hikita teaches a semiconductor device of a chip-on-chip structure comprising a first semiconductor chip and a second semiconductor chip respectively having bumps and connected to each other with the bumps thereof bonded to each other. Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made to bond two semiconductor chips as taught by Kikita wherein at least one of the chips has the semiconductor substrate, bump, diffusion prevention film, and bonding film as taught by Zakel in order to provide an easily producible improved connection that can be easily wetted with solder material.

Allowable Subject Matter

Claim 3 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Telephone / Fax Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Earl N. Taylor whose telephone number is (571) 272-8894. The examiner can normally be reached on Monday-Friday from 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Loke can be reached on (571) 272-1657. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Examiner: Earl N. Taylor

/DAVID VU/
Primary Examiner, Art Unit 2818